APPENDIX 1 - GENERATOR AND STEP-UP TRANSFORMER DATA SHEETS

Note: A separate copy of this five page appendix is required for each individual existing unit, as well as for each individual new unit, at this site. All data entries must be printed in ink or typed, and each page must be signed in ink and dated where indicated. Generator and transformer parameter values should be based on 60Hz operation.

SITE NAME: _____

SITE ADDRESS: _____

OVERVIEW DATA FOR THIS GENERATOR

GENERATOR NUMBER OR OTHER UNIQUE IDENTIFIER: _____

(For the generator described on the following sheets and attached diagrams)

1 GENERATOR IDENTIFICATION

A MANUFACTURER:_____

B MODEL:_____

C SERIAL NUMBER:_____

2 GENERATING CAPABILITY OF THIS UNIT

A NOMINAL / ISO RATING (kilowatts @ power factor):_____

B SUMMER RATING AT 95°F (kilowatts @ power factor):_____

C WINTER RATING AT 30°F (kilowatts @ power factor):_____

3 RATED VOLTAGE (KV):_____

4 RATED SPEED (RPM):_____

5 TYPE OF GENERATOR (synchronous, induction, etc.) AND PRIME MOVER (steam turbine, reciprocating, etc.):_____

6 GENERATOR GROUNDING METHOD (and impedance value if applicable): _____

7 ONE LINE ELECTRICAL DIAGRAM(S) showing anticipated connection to customer's new or existing system and/or connection to ComEd system.

8 DESCRIPTION OF PLANNED CIRCUIT BREAKER CONFIGURATION FOR SYNCHRONIZING THE GENERATOR TO THE GRID (be sure to specify which individual breaker will be used):_____

9 PHYSICAL SITE LOCATION DRAWING(S) OR MAP(S)

10 ANTICIPATED BACKFEED DATE:_____

11 ANTICIPATED COMMERCIAL OPERATION DATE:_____

12 TOTAL NUMBER OF GENERATORS AT THIS SITE: _____

Signature: _____ Date: _____

ComEd

An Exelon Company

MODELING DATA FOR THIS SYNCHRONOUS GENERATOR

SITE NAME: _____

GENERATOR NUMBER OR OTHER UNIQUE IDENTIFIER: _____
(as given on the first sheet)

1 RESISTANCES GIVEN IN PER UNIT ON _____ KVA, _____ KV BASE

A POSITIVE SEQUENCE RESISTANCE: R1:_____

B NEGATIVE SEQUENCE RESISTANCE: R2:_____

C ZERO SEQUENCE RESISTANCE: R0:_____

2 REACTANCES GIVEN IN PER UNIT ON _____ KVA, _____ KV BASE

		Unsaturated	Saturated
A	DIRECT AXIS SYNCHRONOUS REACTANCE:	Xd = _____	, _____
B	DIRECT AXIS TRANSIENT REACTANCE:	X'd = _____	, _____
C	DIRECT AXIS SUBTRANSIENT REACTANCE:	X"d = _____	, _____
D	QUADRATURE AXIS SYNCHRONOUS REACTANCE:	Xq = _____	, _____
E	QUADRATURE AXIS TRANSIENT REACTANCE:	X'q = _____	, _____
F	QUADRATURE AXIS SUBTRANSIENT REACTANCE:	X"q = _____	, _____
G	POSITIVE SEQUENCE REACTANCE:	X1= _____	, _____
H	NEGATIVE SEQUENCE REACTANCE:	X2 = _____	, _____
I	ZERO SEQUENCE REACTANCE:	X0 = _____	, _____
J	STATOR LEAKAGE REACTANCE:	XL = _____	, _____
K	Potier Reactance:	XP = _____	, _____

3 TIME CONSTANTS

A DIRECT AXIS SHORT CIRCUIT TRANSIENT (line-neutral): T'd1 (seconds) = _____

B DIRECT AXIS SHORT CIRCUIT TRANSIENT (line-line): T'd2 (seconds) = _____

C DIRECT AXIS SHORT CIRCUIT TRANSIENT (three phase): T'd3 (seconds) = _____

D DIRECT AXIS SHORT CIRCUIT SUBTRANSIENT (line-neutral): T"d1 (seconds) = _____

E DIRECT AXIS SHORT CIRCUIT SUBTRANSIENT (line-line): T"d2 (seconds) = _____

F DIRECT AXIS SHORT CIRCUIT SUBTRANSIENT (three phase): T"d3 (seconds) = _____

G QUADRATURE AXIS SHORT CIRCUIT TRANSIENT (line-neutral): T'q1 (seconds) = _____

H QUADRATURE AXIS SHORT CIRCUIT TRANSIENT (line-line): T'q2 (seconds) = _____

I QUADRATURE AXIS SHORT CIRCUIT TRANSIENT (three phase): T'q3 (seconds) = _____

J QUADRATURE AXIS SHORT CIRCUIT SUBTRANSIENT (line-neutral): T"q1 (seconds) = _____

MODELING DATA FOR THIS SYNCHRONOUS GENERATOR

3 TIME CONSTANTS (continued)

K QUADRATURE AXIS SHORT CIRCUIT SUBTRANSIENT (line-line): T"q2 (seconds) = _____

L QUADRATURE AXIS SHORT CIRCUIT SUBTRANSIENT (three phase): T"q3 (seconds) = _____

M DIRECT AXIS OPEN CIRCUIT TRANSIENT: T'do (seconds) = _____

N DIRECT AXIS OPEN CIRCUIT SUBTRANSIENT: T"do (seconds) = _____

O QUADRATURE AXIS OPEN CIRCUIT TRANSIENT: T'qo (seconds) = _____

P QUADRATURE AXIS OPEN CIRCUIT SUBTRANSIENT: T"qo (seconds) = _____

Q SHORT CIRCUIT ARMATURE (line-neutral): Ta1 (seconds) = _____

R SHORT CIRCUIT ARMATURE (line-line): Ta2 (seconds) = _____

S SHORT CIRCUIT ARMATURE (three phase): Ta3 (seconds) = _____

4 INERTIA CONSTANT (Including Turbine)
H (in seconds - on machine base):_____ and WR2 (lb-ft^2):_____

5 AUXILLARY LOAD WITH GENERATOR IN SERVICE: _____ KW and _____ KVA

6 ADDITIONAL GENERATOR INFORMATION

A Attach a legible plot of generator open-circuit saturation curve and short circuit characteristic.

B Attach a legible plot of generator reactive capability curves (MVAR output vs. MW output) and V curves.

C Attach all technical data provided by the generator manufacturer.

7 EXCITER, POWER SYSTEM STABILIZER AND GOVERNOR MODELING DATA

A Specify excitation system and power system stabilizer data in accordance with IEEE Standards (refer to "Excitation System Models for Power System Stability Studies", IEEE Transactions on Power Apparatus and Systems, Vol. PAS-100, No. 2, Feb. 1981). If the excitation system can not be properly modeled as an IEEE standard model, ComEd will have a model suitable for extended-term dynamics studies created for the PSS/E engineering simulation program. The developer of the generating facility will be billed for the creation of this model.

B Provide data and block diagram model of turbine and governor

Signature: _____ Date: _____

ComEd.

An Exelon Company

MODELING DATA FOR THIS INDUCTION GENERATOR

SITE NAME: _____

GENERATOR NUMBER OR OTHER UNIQUE IDENTIFIER: _____
(as given on the first sheet)

1 RESISTANCES GIVEN IN PER UNIT ON _____ KVA, _____ KV BASE

A POSITIVE SEQUENCE RESISTANCE:	R1 =	_____
B NEGATIVE SEQUENCE RESISTANCE:	R2 =	_____
C ZERO SEQUENCE RESISTANCE:	R0 =	_____

2 REACTANCES GIVEN IN PER UNIT ON _____ KVA, _____ KV BASE

		UNSATURATED	SATURATED
A SYNCHRONOUS REACTANCE:	X =	_____ ,	_____
B TRANSIENT REACTANCE:	X' =	_____ ,	_____
C SUBTRANSIENT REACTANCE:	X" =	_____ ,	_____
D POSITIVE SEQUENCE REACTANCE:	X1 =	_____ ,	_____
E NEGATIVE SEQUENCE REACTANCE:	X2 =	_____ ,	_____
F ZERO SEQUENCE REACTANCE:	X0 =	_____ ,	_____
G STATOR LEAKAGE REACTANCE:	XL =	_____ ,	_____

3 TIME CONSTANTS

A SHORT CIRCUIT TRANSIENT:	T' (seconds) =	_____
B SHORT CIRCUIT SUBTRANSIENT:	T" (seconds) =	_____
C OPEN CIRCUIT TRANSIENT:	T'o (seconds) =	_____
D OPEN CIRCUIT SUBTRANSIENT:	T"o (seconds) =	_____

4 INERTIA CONSTANT (Including Turbine)
H (in seconds - on machine base): _____ and WR2 (lb-ft^2): _____

5 MECHANICAL POWER USED AT SYNCHRONOUS SPEED (MW): _____

6 TORQUE AT SYNCHRONOUS SPEED (pu): _____

7 AUXILIARY LOAD WITH GENERATOR IN SERVICE: _____ KW and _____ KVA

8 ADDITIONAL GENERATOR INFORMATION
A Attach a legible plot of generator open-circuit saturation curve and short circuit characteristic.
B Attach a legible plot of generator reactive capability curves (MVAR output vs. MW output) and V curves.

9 PROVIDE DATA AND BLOCK DIAGRAM MODEL OF TURBINE AND GOVERNOR

Contact ComEd for the data submission requirements for this type of generator.

Signature: _____ Date: _____

MODELING DATA FOR THE STEP-UP TRANSFORMER FOR THIS GENERATOR

SITE NAME: _____

GENERATOR NUMBER OR OTHER UNIQUE IDENTIFIER: _____
(as given on the first sheet)

1 TRANSFORMER IDENTIFICATION

A MANUFACTURER: _____

B MODEL/TYPE: _____

C SERIAL NUMBER: _____

2 TRANSFORMER DATA

A RATINGS (KVA): _____

B HIGH VOLTAGE WINDING Nominal Voltage (KV): _____
CONNECTED grounded wye/ungrounded wye/grounded through impedance wye/delta (list impedance and base if applicable): _____

C LOW VOLTAGE WINDING Nominal Voltage (KV): _____
CONNECTED grounded wye/ungrounded wye/grounded through impedance wye/delta (list impedance and base if applicable): _____

3 IMPEDANCES GIVEN IN PER UNIT ON _____ KVA, _____ KV BASE

A POSITIVE SEQUENCE RESISTANCE: R1 = _____

B NEGATIVE SEQUENCE RESISTANCE: R2 = _____

C ZERO SEQUENCE RESISTANCE: R0 = _____

D POSITIVE SEQUENCE REACTANCE: X1 = _____

E NEGATIVE SEQUENCE REACTANCE: X2 = _____

F ZERO SEQUENCE REACTANCE: X0 = _____

4 TAP SETTINGS

A ALL AVAILABLE TAP SETTINGS

H.V. Taps (KV): _____

L.V. Taps (KV): _____

B EXPECTED TAP SETTINGS

H.V. Tap (KV): _____ L.V. Tap (KV): _____

The data for the individual generator and step-up transformer provided above in this appendix is certified as complete and accurate. Any additional engineering studies, infrastructure changes, delays, or equipment damage due to missing or inaccurate data is the responsibility of the generator developer. This data will be verified as accurate and complete immediately **prior** to the generating units being commissioned and every 4 years afterwards (or as directed by NERC/NAERO policy once it has been finalized). Any changes in the data above once the generators are in-service must be immediately provided to ComEd.

Name (printed): _____

Signature: _____ Date: _____

Title: _____ Email: _____

Company: _____

Address: _____

Phone: _____ Fax: _____

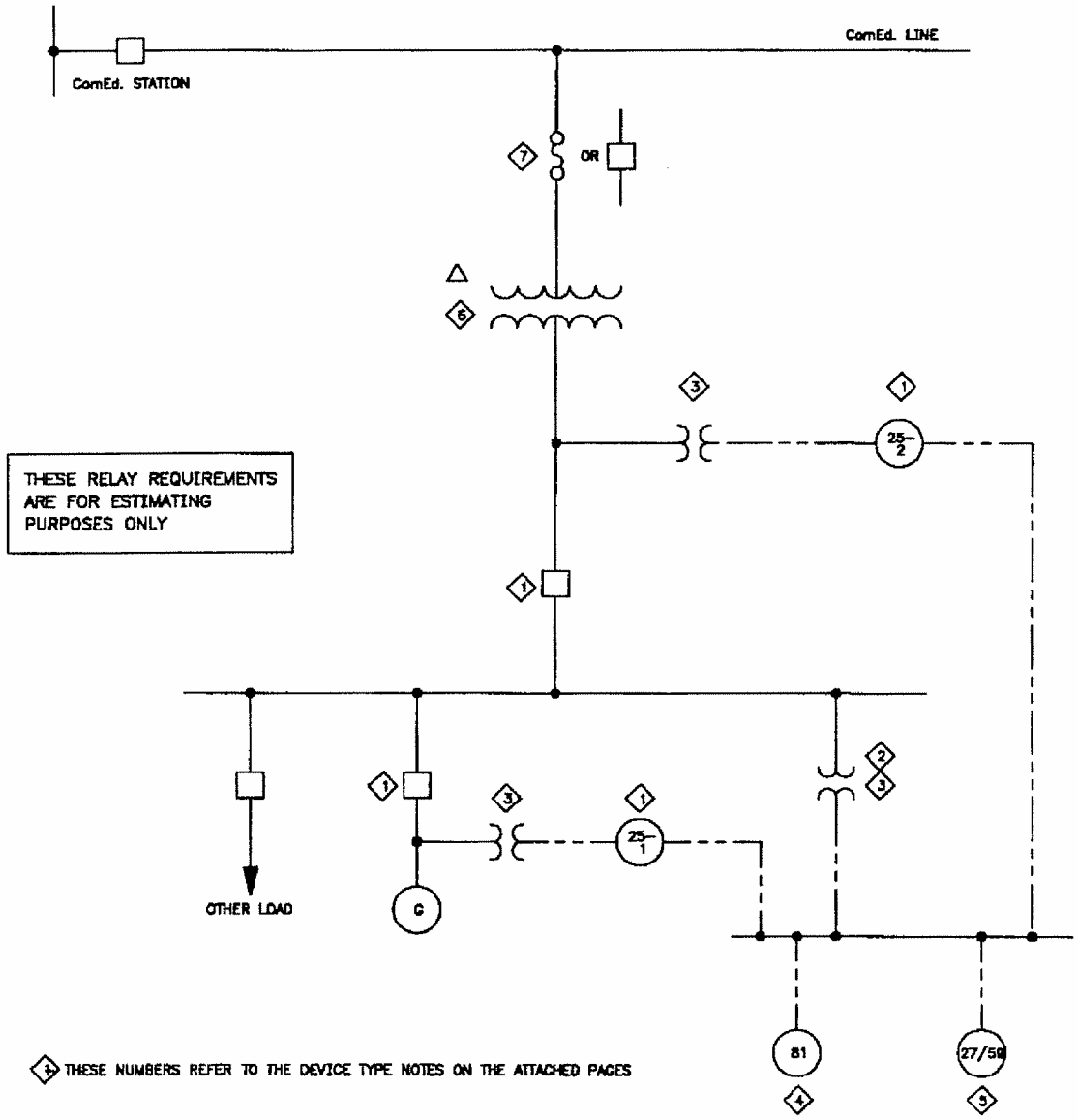
APPENDIX 2: PLAN A GENERAL REQUIREMENTS FOR GENERATING CAPACITY 25 TO 2500KVA

PRELIMINARY RELAY REQUIREMENTS
CUSTOMER OWNED GENERATION PARALLELED WITH ComEd.
FOR PRELIMINARY REPLY TO SERVICE ESTIMATE REQUEST

PLAN A

THIS PLAN IS FOR GENERATION FACILITIES WITH THE FOLLOWING CHARACTERISTICS:

A. TOTAL GENERATION IS LESS THAN 50% OF THE MINIMUM LINE LOAD.
----AND----
B. TOTAL GENERATION IS LESS THAN 2500KVA



PLAN_A
S00BVF

Plan A - Notes for Relay Functional Requirements Specification (RFRS) Form and Preliminary Relay Requirements Diagram

This plan is for Generation Facilities with the following characteristics:

a. Total generation is less than 50% of the minimum line load.

—and—

b. Total generation is less than 2500kVA.

Relay requirement/recommendation and installer are dependent upon ComEd/Customer property line location. Required relays are to be approved by ComEd.

W: Protection required by ComEd due to customer's parallel generation; to be installed by ComEd at customer's expense.

X: Protection required by ComEd due to customer's parallel generation; to be installed by customer at customer's expense.

Y: Protection recommended by ComEd due to customer's parallel generation; to be installed by customer at customer's expense.

Z: Protection recommended by ComEd due to customer's parallel generation; to be installed by ComEd at customer's expense.

EX: Existing relay or equipment.

N/A: Not applicable in this case.

IN: Equipment to be installed.

Additional Notes Pertaining to Each Device Type

1. ____ Device Type: Synchronizing Relay Device #: 25

   Number Required: as required by the number of generator and transformer breakers needing synchrochecking. Not needed for most induction type generators.

   Purpose: Provide for proper closing of breakers when customer generator(s) are to be paralleled to the ComEd system.

2. ____ Device Type: Voltage Transformer

   Number Required: 3 connected grounded-wye/grounded-wye

   Purpose: Provide voltage for under/over voltage and under/over frequency relays.

3. ____ Device Type: Voltage Transformer

   Number Required: as required for synchronizing

   Purpose: Provide voltage for synchronizing relays. May be one connected phase to phase or may be part of a 3 phase voltage transformer package.

Plan A - Notes for Relay Functional Requirements Specification (RFRS) Form and Preliminary Relay Requirements Diagram (continued)

4. ____ Device Type: Under/over Frequency Relay Device #: 81U/O

   Number Required: 1

   Purpose: Provide tripping of customer breaker in the event the frequency fails to be maintained. This relay would be expected to operate if the customer should become isolated on the ComEd line and not be able to maintain the load. The relay should be a definite-time type with a capability of providing a trip time in the .5 second to 2 second range. A solid-state definite time type relay is recommended. The actual setting is to be determined on a case-by-case basis.

5. ____ Device Type: Under/over voltage relay Device #: 27/59

   Number Required: depends on type

   Purpose: Provide tripping of customer breaker should the feeder or line voltage not be maintained within acceptable limits. This relay should be a definite-time type or an instantaneous type with a timer. The relay should be capable of providing a trip time in the .5 second to 2 second range. The actual setting is to be determined on a case-by-case basis.

6. ____ Device Type: Power Transformer

   Number Required: As needed

   High voltage connection: Delta.

7. ____ Device Type: Interrupting Device

   Number Required: As needed

   Purpose: May be a fuse or circuit breaker. Circuit breaker must not be dependent upon A.C. power for tripping.

Relay Functional Requirements Specifications - Plan A

CUSTOMER: _____ P.D. _____ Ser No.: _____

Location: _____ Date: _____

Connected To: _____ First Issued: _____

The information below must be furnished by the customer and returned to Commonwealth Edison company						Notes refer to "preliminary" relay requirements for **PLAN A** Note #	Initiated by relays at left, as indicated				
DEVICE NO.	FUNCTION	TYPE*	CONN.	C.T. RATIO	P.T. RATIO		LBB	TRIP TRANS C.B.	TRIP GEN C.B.	TRIP LINE C.B.	SUPV. CLOSE
25-1	SYNCHRONIZING					1					
25-2	SYNCHRONIZING					1					
27/59	UNDER/OVER VOLTAGE					5					
81	UNDER/OVER FREQ.					4					

*Relays should be approved by ComEd before customer purchase.

ADDITIONAL NOTES: _____

RETURN TO: _____
(Engineer)

ADDRESS: ComEd
Relay and Protection Services
2 Lincoln Center
Oak Brook Terrace IL, 60181-4260

RETURNED BY: _____
CUSTOMER/CONSULTANT (Signature/Date)

ComEd
An Exelon Company

ComEd.

An Exelon Company

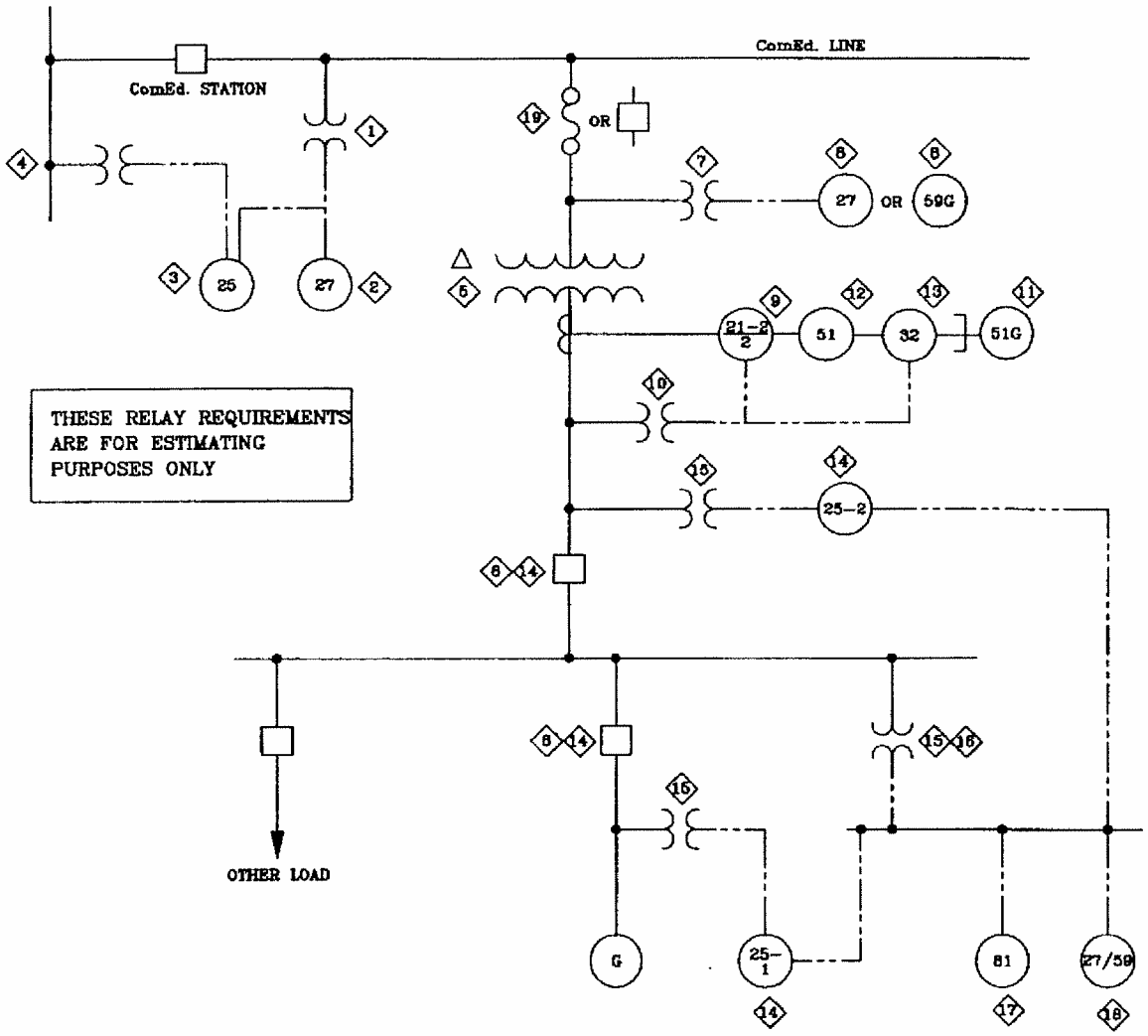
APPENDIX 3: PLAN B GENERAL REQUIREMENTS FOR GENERATING CAPACITY GREATER THAN 2500KVA TO 10MVA

PRELIMINARY RELAY REQUIREMENTS
CUSTOMER OWNED GENERATION PARALLELED WITH ComEd.
FOR REPLY TO SERVICE ESTIMATE REQUEST

PLAN B

THIS PLAN IS FOR GENERATION FACILITIES WITH THE FOLLOWING CHARACTERISTICS:

A. TOTAL GENERATION IS GREATER THAN OR EQUAL TO 50% OF THE MINIMUM LINE LOAD.
----OR----
B. TOTAL GENERATION IS GREATER THAN OR EQUAL TO 2500KVA AND LESS THAN 10MVA.
C. SPECIAL SYSTEM CONSTRAINTS WARRANT USING THIS PLAN.



◇ THESE NUMBERS REFER TO THE DEVICE TYPE NOTES ON THE ATTACHED PAGES.

PLAN_B

Plan B - Notes for Relay Functional Requirements Specification (RFRS) Form and Preliminary Relay Requirements Diagram

This plan is for Generation Facilities with the following characteristics:

a. Total generation is greater than or equal to 50% of the minimum line load.

—or—

b. Total generation is greater than 2500kVA and less than 10 MVA.

—or—

c. Special system constraints warrant using this plan.

W: Protection required by ComEd due to customer's parallel generation; to be installed by ComEd at customer's expense.

X: Protection required by ComEd due to customer's parallel generation; to be installed by customer at customer's expense.

Y: Protection recommended by ComEd due to customer's parallel generation; to be installed by customer at customer's expense.

Z: Protection recommended by ComEd due to customer's parallel generation; to be installed by ComEd at customer's expense.

EX: Existing relay or equipment.

N/A: Not applicable in this case.

IN: Equipment to be installed.

Additional Notes Pertaining to Each Device Type

1. ____ Device Type: Voltage Transformer

   Number Required: 3 connected grounded-wye/grounded-wye

   Purpose: Provide voltage for manual and automatic closing of source station breaker.

2. ____ Device Type: Undervoltage Relay Device #: 27

   Number Required: 3 (may be part of auto-reclosing relay-device type 79)

   Purpose: Provide voltage supervision for closing of source station breaker. Breaker may be closed if all 3 phases aredead.

3 ____ Device Type: Synchrocheck Relay Device #: 25

   Number Required: As required (depends on type)

   Purpose: To provide voltage and phase angle supervision for manual and supervisory closing of source station breaker. Breaker will be manually closed for any of the following indicated conditions, as requested by _____:

   ____ Live bus - Live line synchronized
   ____ Live bus - Dead line
   ____ Dead bus - Live line
   ____ Dead bus - Dead line
   ____ Not required

Plan B - Notes for Relay Functional Requirements Specification (RFRS) Form and Preliminary Relay Requirements Diagram (continued)

4. ____ Device Type: Voltage Transformer

   Number Required: Depends on type of synchrocheck relay

   Purpose: Provide bus voltage for synchrocheck relay

5 ____ Device Type: Power Transformer

   Number Required: As needed

   High voltage connection: Delta.

6. ____ Device Type: Breaker Failure Backup Tripping (i.e. LBB)

   Number Required: 1 (may consist of several relays)

   Purpose: Provide for tripping of customer generator breaker in the event that the interface breaker fails totrip. This relay to be initiated by any customer line fault relay.

7. ____ Device Type: Voltage Transformer

   Number Required: 3 connected grounded-wye line side and either broken-delta or grounded-wye on secondary side.

   Purpose: Provide voltage to 59G or 27 relays for faults involving ground on the ComEd system. Preferred connection is broken-delta; but if feeder loading is unbalanced to the point that three times zero-sequence voltage is normally significant, then the secondary side should be connected grounded-wye. If this VT is to provide voltage also for impedance relays or directional relays and is to be used for a 59G relay, then the VT may be a three winding type with the third winding connected grounded-wye or the broken-delta connection may be provided by using an aux. VT (grounded-wye/broken-delta) if the main VT is grounded-wye/grounded-wye.

8. ____ Device Type: Over or Undervoltage Relays Device #:59G or 27

   Number Required: 1 if 59G or 3 if 27 relay

   Purpose: Provide tripping of customer breaker(s) in the event of a fault on the ComEd system involving ground. If the VT's are connected broken-delta, then the relay used is the 59G overvoltage type. If the VT's are connected grounded-wye on the secondary, then the relays used are the 27 undervoltage relays.

9. ____ Device Type: Impedance Relay Plus Timer Device #: 21-2/2

   Number Required: 1 Impedance relay plus 1 timer

   Purpose: Provide for tripping of customer breaker in the event of a phase fault on the ComEd system. This relay is used in a Zone 2 mode. The timer should be capable of providing a trip time in the .5 second to 2 seconds range.

Plan B - Notes for Relay Functional Requirements Specification (RFRS) Form and Preliminary Relay Requirements Diagram (continued)

10.____ Device Type: Voltage Transformer

Number Required: 3 connected grounded-wye/grounded-wye

Purpose: Provide voltage for impedance relays and power directional relays.

11.____ Device Type: Ground Overcurrent Relay Device #: 51G

Number Required: 1

Purpose: Provide for tripping of customer breaker in the event of a fault involving ground on the customer system. This relay may be in the transformer neutral.

12.____ Device Type: Overcurrent Relay Device #: 51

Number Required: 3 or 1 3-phase

Purpose: Provide for tripping of customer breaker in the event of a phase fault on the customer system.

13.____ Device Type: Directional Power Relay Device #: 32

Number Required: 1 or 3 depending on type

Purpose: Provide for tripping of customer breaker if the transformer size is smaller than generator, to limit power out if necessary to prevent damage to other customers, or to limit power out because of ComEd system constraints. This relay is not used for fault detection.

14.____ Device Type: Synchronizing Relay Device #: 25

Number Required: As required by the number of generator and transformer breakers needing synchrochecking. Not needed for most induction-type machines.

Purpose: Provide for proper closing of breakers when the customer generator(s) are to be paralleled to the ComEd system.

15.____ Device Type: Voltage Transformer

Number Required: As required for synchronizing

Purpose: Provide voltage for synchronizing relays. May be one connected phase-to-phase or may be a part of a 3-phase voltage transformer package.

16.____ Device Type: Voltage Transformer

Number Required: 3 connected grounded-wye/grounded-wye

Purpose: Provide voltage for under/over voltage and under/over frequency relays.

Plan B - Notes for Relay Functional Requirements Specification (RFRS) Form and Preliminary Relay Requirements Diagram (continued)

17. Device Type: Under/over Frequency Relay Device #: 81U/O

Number Required: 1

Purpose: Provide tripping of customer breaker in the event the frequency fails to be maintained. This relay would be expected to operate if the customer should become isolated on the ComEd line and not be able to maintain the load. The relay should be a definite-time type with a capability of providing a trip time in the .5 second to 2 second range. A solid-state definite time type relay is recommended. The actual setting is to be determined on a case-by-case basis.

18. Device Type: Under/over voltage relay Device #: 27/59

Number Required: Depends on type

Purpose: Provide tripping of customer breaker should the feeder or line voltage not be maintained within acceptable limits. This relay should be a definite-time type or an instantaneous type with a timer. The relay should be capable of providing a trip time in the .5 second to 2 second range. The actual setting is to be determined on a case-by-case basis.

19. Device Type: Interrupting Device

Number Required: As needed

Purpose: May be a fuse or circuit breaker. Circuit breaker must not be dependent upon A.C. power for tripping.

Relay Functional Requirements Specifications - Plan B

CUSTOMER: _____ P.O. _____ Ser No.: _____

Location: _____ Date: _____

Connected To: _____ First Issued: _____

The customer must furnish the information below and return to Commonwealth Edison company						Notes refer to "preliminary" relay requirements for **PLAN B** Note #	Initiated by relays at left, as indicated				
DEVICE NO.	FUNCTION	TYPE*	CONN.	C.T. RATIO	P.T. RATIO		LBB	TRIP TRANS C.B.	TRIP GEN C.B.	TRIP LINE C.B.	SUPV. CLOSE
25-1	SYNCHRONINZING					14					
25-2	SYNCHRONINZING					14					
27/59	UNDER/OVER VOLTAGE					18					
	LBB					6					
27	UNDERVOLTAGE					8					
59G	OVERVOLTAGE					8					
21-2/2	IMPEDANCE & TIMER					9					
51	OVERCURRENT					12					
32	DIRECTIONAL POWER					13					
51G	GROUND OVERCURRENT					11					
81	UNDER/OVER FREQ.					17					

*Relays should be approved by ComEd before customer purchase.

ADDITIONAL NOTES: _____

_____

_____

_____

_____

_____

_____

RETURN TO: _____
(Engineer)

ADDRESS: ComEd
Relay and Protection Services
2 Lincoln Centre
Oakbrook Terrace, Illinois 60181-4260

RETURNED BY: _____
CUSTOMER/CONSULTANT (Signature/Date)

ComEd
An Exelon Company

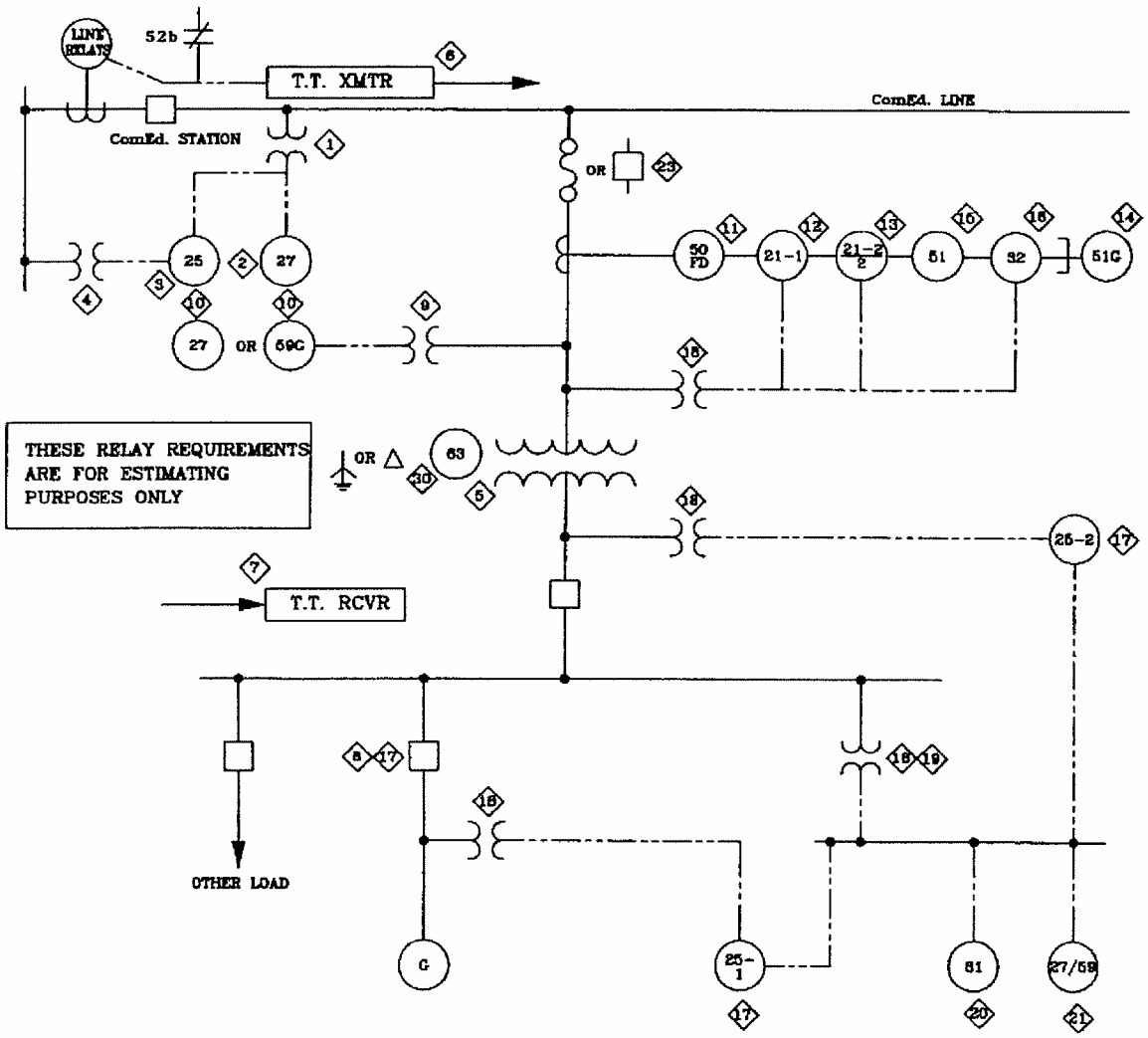
APPENDIX 4: PLAN C GENERAL REQUIREMENTS FOR GENERATING CAPACITY OVER 10MVA OR CONNECTED TO THE TRANSMISSION SYSTEM

PRELIMINARY RELAY REQUIREMENTS
CUSTOMER OWNED GENERATION PARALLELED WITH ComEd.
FOR REPLY TO SERVICE ESTIMATE REQUEST

PLAN C

THIS PLAN IS FOR GENERATION FACILITIES WITH THE FOLLOWING CHARACTERISTICS:

A. GENERATION LESS THAN 10 MVA CONNECTED TO 69KV OR 138KV.
----OR----
B. GENERATION GREATER THAN OR EQUAL TO 10 MVA CONNECTED TO THE DISTRIBUTION SYSTEM.
----OR----
C. SPECIAL SYSTEM CONSTRAINTS WARRANT USING THIS PLAN.



SPFIGP-C
PK_005DQ

Plan C - Notes for Relay Functional Requirements Specification (RFRS) Form and Preliminary Relay Requirements Diagram

This plan is for Generation Facilities with the following characteristics:

a. Total generation power rating is greater than or equal to 10MVA.

—or—

b. The ComEd supply line voltage is 69kV or above.

—or—

c. Special system constraints warrant using this plan.

Relay requirement/recommendation and installer are dependent upon ComEd/Customer property line location. Required relays are to be approved by ComEd.

W: Protection required by ComEd due to customer's parallel generation; to be installed by ComEd at customer's expense.

X: Protection required by ComEd due to customer's parallel generation; to be installed by customer at customer's expense.

Y: Protection recommended by ComEd due to customer's parallel generation; to be installed by customer at customer's expense.

Z: Protection recommended by ComEd due to customer's parallel generation; to be installed by ComEd at customer's expense.

EX: Existing relay or equipment.

N/A: Not applicable in this case.

IN: Equipment to be installed.

Additional Notes Pertaining to Each Device Type

1. ____ Device Type: Voltage Transformer

   Number Required: 3 connected grounded-wye / grounded-wye

   Purpose: Provide voltage for manual and automatic closing of source station breaker.

2. ____ Device Type: Undervoltage Relay Device #: 27

   Number Required: 3 (may be part of auto-reclosing relay device #79)

   Purpose: Provide voltage supervision for closing of source station breaker. Breaker may be closed if all 3 phases are dead.

3. ____ Device Type: Synchrocheck Relay Device #:25

   Number Required: As required (depends on type)

   Purpose: Provide voltage and phase angle supervision for manual and supervisory closing of source station breaker. Breaker will be manually closed for any of the following indicated conditions as requested by ComEd.

   ____ Live bus - Live line synchronized
   ____ Live bus - Dead line
   ____ Dead bus - Live line
   ____ Dead bus - Dead line
   ____ Not required

Plan C - Notes for Relay Functional Requirements Specification (RFRS) Form and Preliminary Relay Requirements Diagram (continued)

4. ____ Device Type: Voltage Transformer

   Number Required: Depends on type of synchrocheck relay

   Purpose: Provide bus voltage for synchrocheck relay

5. ____ Device Type: Power Transformer

   Number Required: As needed

   High voltage connection: Delta for 12kV system. Delta or grounded wye for higher voltage systems; exact connection determined on a case-by-case basis.

6. ____ Device Type: Transferred Trip Transmitter

   Number Required: 1

   Purpose: Provide for tripping of customer breaker in the event that the source station breaker should open. May be keyed by line relaying, bus relaying or 52b contact.

7. ____ Device Type: Transferred Trip Receiver

   Number Required: 1

   Purpose: Receive transferred trip signal from source station so as to trip the customer breaker.

8. ____ Device Type: Breaker Failure backup tripping (i.e. LBB)

   Number Required: 1 (may consist of several breakers)

   Purpose: Provide for tripping of the customer generator breaker in the event that the interface breaker fails to trip. This relay to be initiated by any customer line fault relay.

9. ____ Device Type: Voltage Transformer

   Number Required: 3 connected grounded wye line side and either broken-delta or grounded-wye on secondary side.

   Purpose: Provide voltage to 59G or 27 relay for faults involving ground on the ComEd system. Preferred connection is broken-delta but if feeder loading is unbalanced to the point that the 3 times zero sequence voltage is normally significant, then the secondary side should be connected grounded-wye. If this VT is to provide voltage also for impedance relays or directional relays and is to be used for a 59G relay, then the VT may be 3 winding type with the third winding connected grounded-wye or the broken-delta connection may be provided by using an aux. VT (grounded-wye/broken-delta) in conjunction with VT provided by note 22.

10. ____ Device Type: Over or Undervoltage Relays Device #: 59G or 27

    Number Required: 1 if 59G relay or 3 if 27 relay

    Purpose: Provide for tripping of customer breaker(s) via time delay in the event of a fault of ComEd system involving ground. If the VT's are connected broken-delta then the relays used is the 59G overvoltage type. If the VT's are connected grounded-wye on the secondary, then the relays used are the 27 undervoltage relays.

Plan C - Notes for Relay Functional Requirements Specification (RFRS) Form and Preliminary Relay Requirements Diagram (continued)

11.____ Device Type: Fault Detector Device #: 50FD

Number Required: 1 or 3 depending on type. CT ratio is

Purpose: Fault Detector for 21-1 and 21-2 relays (notes 12 and 13).

12.____ Device Type: Impedance Relay Device #: 21-1

Number Required: 1

Purpose: Provide for tripping of customer breaker in the event of a phase fault on the ComEd system. This relay is the Zone 1 impedance relay. This relay may be part of a stepped zone phase and ground distance relay package. If CT's are located on the low voltage side of the transformer and the VT is on the high voltage side, then this relay must receive delta current. See note 22 for required VT location. This relay may not be suitable for all locations.

13.____ Device Type: Impedance Relay plus Timer Device #: 21-2/2

Number Required: 1 Impedance Relay plus 1 Timer

Purpose: Provide for tripping of customer breaker in the event of a phase fault on the ComEd system. This relay is the Zone 2 impedance relay. This relay may be part of a stepped zone phase and ground distance relay package. If CT's are located on the low voltage side of the transformer and the VT is on the high voltage side, then this relay must receive delta current. See note 22 for required VT location. This relay may be on low voltage side (using CT's and VT's located on the low voltage side) if no 21-1 relay is used. The time should be capable of providing a trip time in the .5 second to 2 seconds range.

14.____ Device Type: Ground Overcurrent Relay Device #: 51G

Number Required: 1

Purpose: Provide for tripping of customer breaker in the event of a phase fault involving ground on the customer system. This relay may be in the customer neutral.

15.____ Device Type: Overcurrent Relay Device #: 51

Number Required: 1

Purpose: Provide for tripping of the customer breaker in the event of a phase fault on the customer system.

16.____ Device Type: Directional Power Relay Device #: 32

Number Required: 1 or 3 depending on type.

Purpose: Provide for tripping of the customer breaker if transformer size is smaller than generator, to limit power out if necessary to prevent damage to other customers, or to limit power out because of ComEd system constraints. This relay is not used for fault detection. This relay may be located in a CT located on the transformer secondary.

Plan C - Notes for Relay Functional Requirements Specification (RFRS) Form and Preliminary Relay Requirements Diagram (continued)

17.____ Device Type: Synchronizing Relay Device #: 25

Number Required: as required by the number of generator and transformer breakers needing synchrochecking. Not needed for most induction type generators.

Purpose: Provide for proper closing of breakers when customer generator(s) are to be paralleled to the ComEd system.

18.____ Device Type: Voltage Transformer

Number Required: as required for synchronizing

Purpose: Provide voltage for synchronizing relays. May be one connected phase to phase or may be part of a 3 phase voltage transformer package.

19.____ Device Type: Voltage Transformer

Number Required: 3 connected grounded-wye/grounded-wye

Purpose: Provide voltage for under/over voltage and under/over frequency relays.

20.____ Device Type: Under/over Frequency Relay Device #: 81U/O

Number Required: 1

Purpose: Provide tripping of customer breaker in the event the frequency fails to be maintained. This relay would be expected to operate if the customer should become isolated on the ComEd line and not be able to maintain the load. The relay should be a definite-time type with a capability of providing a trip time in the .5 second to 2 second range. A solid-state definite time type relay is recommended. The actual setting is to be determined on a case-by-case basis.

21.____ Device Type: Under/over voltage relay Device #: 27/59

Number Required: depends on type

Purpose: Provide tripping of customer breaker should the feeder or line voltage not be maintained within acceptable limits. This relay should be a definite-time type or an instantaneous type with a timer. The relay should be capable of providing a trip time in the .5 second to 2 second range. The actual setting is to be determined on a case-by-case basis.

22.____ Device Type: Voltage Transformer

Number Required: 3 connected grounded-wye/grounded-wye

Purpose: Provide voltage for impedance relays and power directional relays. May be part of same transformer package as described in note 19.

23.____ Device Type: Interrupting Device

Number Required: As needed

Purpose: May be a fuse or circuit breaker. Circuit breaker must not be dependent upon A.C. power for tripping.

Relay Functional Requirements Specifications - Plan C

ComEd
An Exelon Company

CUSTOMER: _____ P.D. ____ Ser No.: _____

Location: _____ Date: _____

Connected To: _____ First Issued: _____

The customer must furnish the information below and return to Commonwealth Edison company						Notes refer to "preliminary" relay requirements for **PLAN C** Note #	Initiated by relays at left, as indicated				
DEVICE NO.	FUNCTION	TYPE*	CONN.	C.T. RATIO	P.T. RATIO		LBB	TRIP TRANS C.B.	TRIP GEN C.B.	TRIP LINE C.B.	SUPV. CLOSE
25-1	SYNCHRONISM CHECK					17					
25-2	SYNCHRONISM CHECK					17					
27/59	UNDER/OVER VOLTAGE					21					
	LBB					8					
27	UNDERVOLTAGE					10					
59G	OVERVOLTAGE					10					
21-1	IMPEDANCE					12					
21-2/2	IMPEDANCE & TIMER					13					
50FD	FAULT DETECTOR					11					
32	DIRECTIONAL POWER					16					
51	OVERCURRENT					15					
51G	GROUND OVERCURRENT					14					
81	UNDER/OVER FREQ.					20					
	TRANSFER TRIP RCVR.					7					

*Relays should be approved by ComEd before customer purchase.

ADDITIONAL NOTES: _____

RETURN TO: _____
(Engineer)

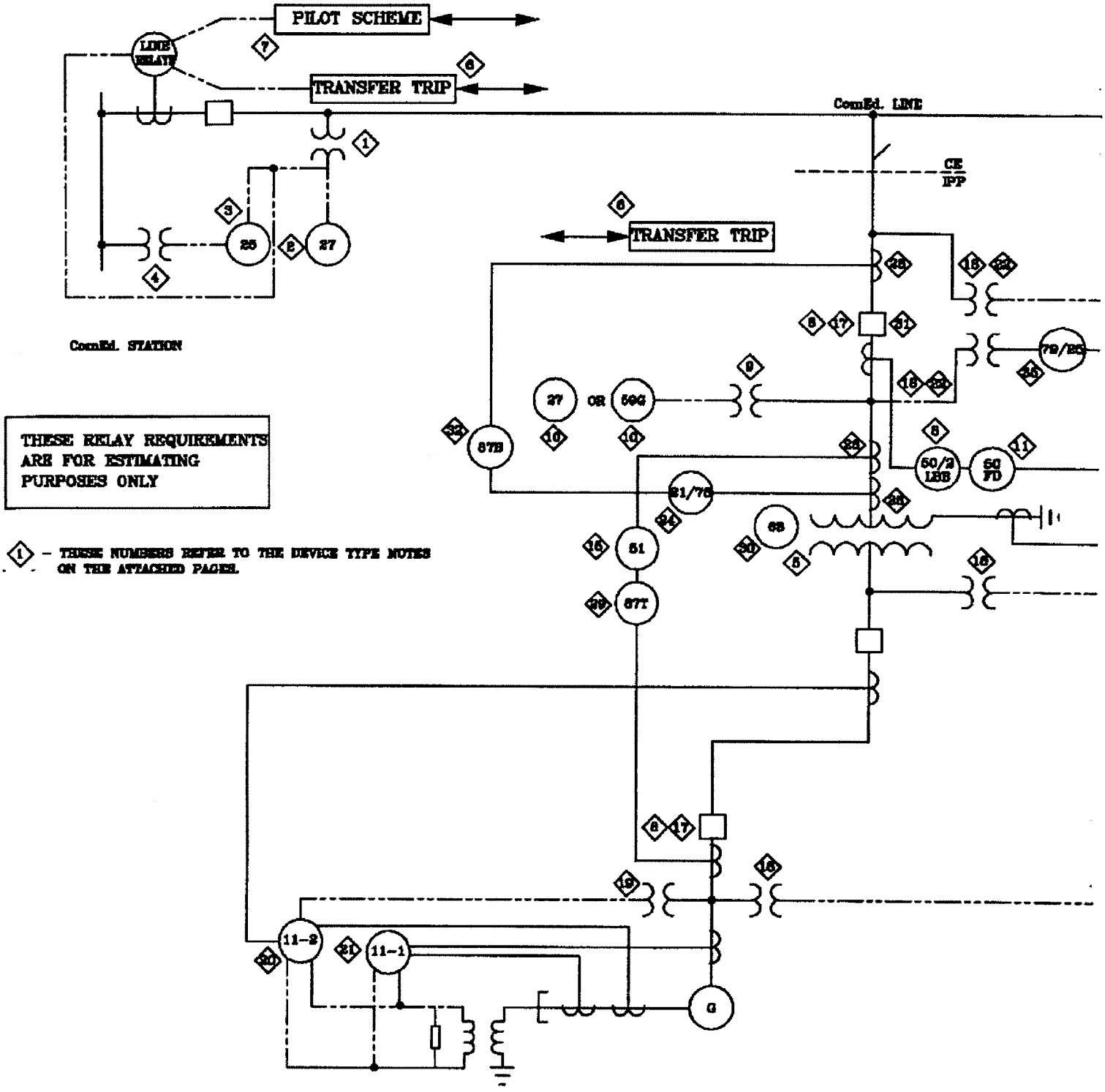
ADDRESS: ComEd
Relay and Protection Services
2 Lincoln Centre
Oakbrook Terrace, Illinois 60181-4260

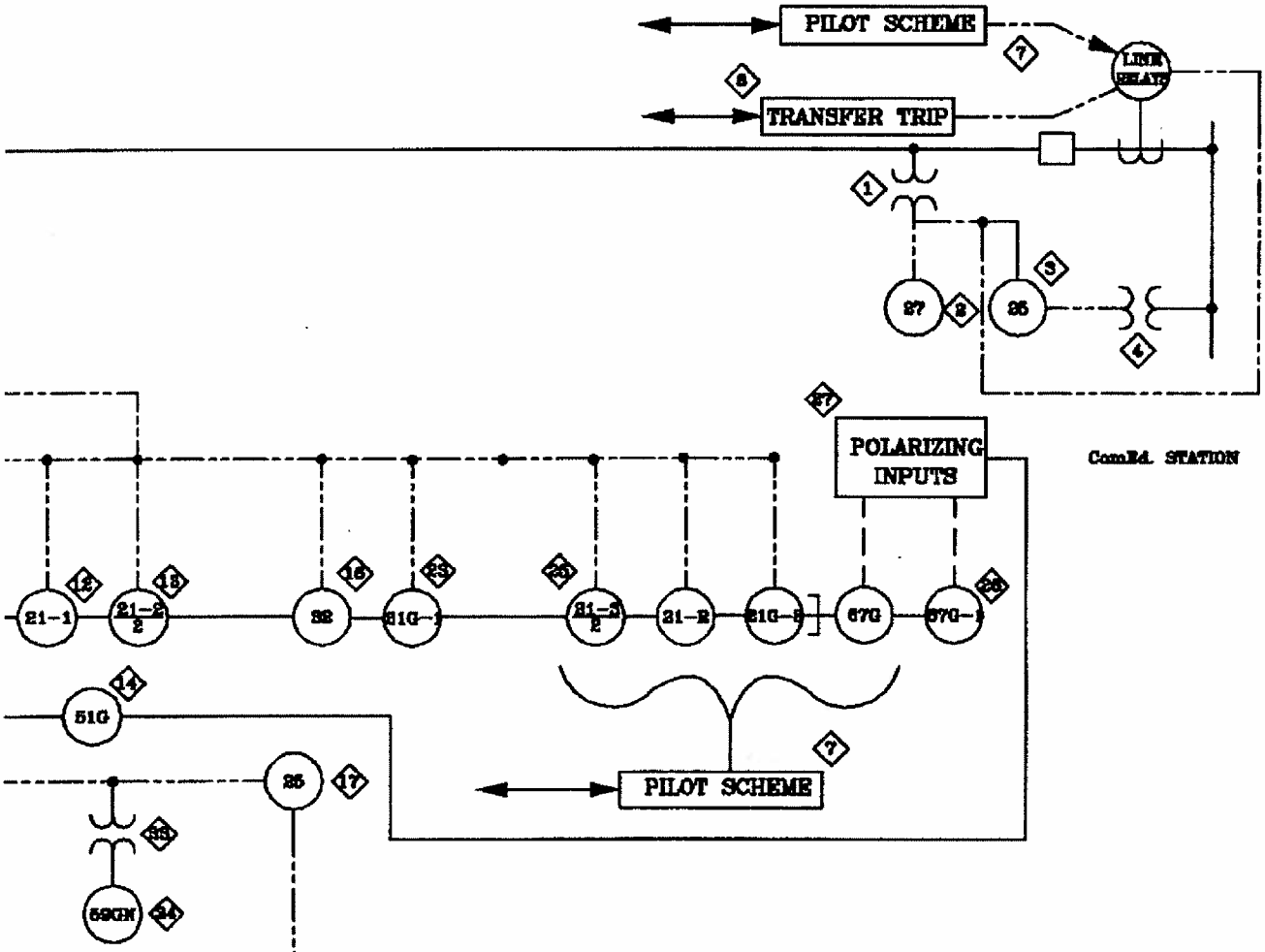
RETURNED BY: _____
CUSTOMER/CONSULTANT (Signature/Date)

ComEd

An Exelon Company

APPENDIX 5: PLAN D GENERAL REQUIREMENTS FOR GENERATING CAPACITY OVER 10MVA AND CONNECTED TO THE TRANSMISSION SYSTEM





PRELIMINARY RELAY REQUIREMENTS
CUSTOMER OWNED GENERATION PARALLELED WITH ComEd.
FOR REPLY TO SERVICE ESTIMATE REQUEST

PLAN D

THIS PLAN IS FOR GENERATION FACILITIES WITH THE FOLLOWING CHARACTERISTICS:

A. TOTAL GENERATION POWER RATING IS GREATER THAN OR EQUAL TO 10MVA AND CONNECTED TO 69KV OR 138KV.

-----OR-----

B. SPECIAL SYSTEM CONSTRAINTS WARRANT USING THIS PLAN.

BLUE BK PLAN_D

PLAN_D
S00BYS

ComEd

An Exelon Company

Plan D - Notes for Relay Functional Requirements Specification (RFRS) Form and Preliminary Relay Requirements Diagram

This plan is for Generation Facilities with the following characteristics:

a. Total generation power rating is greater than or equal to 10MVA.

—and—

b. The ComEd supply line voltage is 69kV or above.

—or—

c. Special system constraints warrant using this plan.

Relay requirement/recommendation and installer are dependent upon ComEd/Customer property line location. Required relays are to be approved by ComEd.

W: Protection required by ComEd due to customer's parallel generation; to be installed by ComEd at customer's expense.

X: Protection required by ComEd due to customer's parallel generation; to be installed by customer at customer's expense.

Y: Protection recommended by ComEd due to customer's parallel generation; to be installed by customer at customer's expense.

Z: Protection recommended by ComEd due to customer's parallel generation; to be installed by ComEd at customer's expense.

EX: Existing relay or equipment.

N/A: Not applicable in this case.

IN: Equipment to be installed.

Additional Notes Pertaining to Each Device Type

1. ____ Device Type: Voltage Transformer

   Number Required: 3 connected grounded-wye / grounded-wye

   Purpose: Provide voltage for manual and automatic closing of source station breaker.

2. ____ Device Type: Undervoltage Relay Device #: 27

   Number Required: 3 (may be part of auto-reclosing relay device #79)

   Purpose: Provide voltage supervision for closing of source station breaker. Breaker may be closed if all 3 phases are dead.

Plan D - Notes for Relay Functional Requirements Specification (RFRS) Form and Preliminary Relay Requirements Diagram (continued)

3. ____ Device Type: Synchrocheck Relay Device #:25

   Number Required: As required (depends on type)

   Purpose: Provide voltage and phase angle supervision for manual and supervisory closing of source station breaker. Breaker will be manually closed for any of the following indicated conditions as requested by :

   ____ Live bus - Live line synchronized
   ____ Live bus - Dead line
   ____ Dead bus - Live line
   ____ Dead bus - Dead line
   ____ Not required

4. ____ Device Type: Voltage Transformer

   Number Required: Depends on type of synchrocheck relay

   Purpose: Provide bus voltage for synchrocheck relay

5. ____ Device Type: Power Transformer

   Number Required: As needed

   High voltage connection: Delta for 12kV system. Delta or grounded wye for higher voltage systems; exact connection determined on a case-by-case basis.

6. ____ Device Type: Transferred Trip Transmitter/Receiver

   Number Required: As needed

   Purpose: Provide for tripping of customer breaker in the event that the source station breaker should open or a fault on the ComEd line is detected. May be keyed by line relaying, bus relaying or 52b contact. System constraints may require a transmitter at the customer location to trip source station breaker(s) if local breaker fails or if a fault on the ComEd line is detected.

7. ____ Device Type: Pilot Protection Scheme

   Number Required: 1

   Purpose: To provide high-speed fault clearing on the ComEd line. This high-speed protection requires communication between all sources of energy to the fault. The pilot protection scheme at the customer location must be compatible with the pilot protection scheme at the ComEd source station(s). The pilot protection scheme most commonly used is directional comparison however other schemes are used. The directional comparison scheme will usually include the following:

Zone 3 phase distance relay (see note 25)	Device #: 21-3
Reverse looking phase distance relay	Device #: 21-R
Zone 3 ground distance relay	Device #: 21G-3
Ground directional overcurrent relay	Device #: 67G

Plan D - Notes for Relay Functional Requirements Specification (RFRS) Form and Preliminary Relay Requirements Diagram (continued)

8. ____ Device Type: Breaker Failure backup tripping (i.e. LBB)

   Number Required: 1 (may consist of several breakers)

   Purpose: Provide for tripping of the customer generator breaker in the event that the interface breaker fails to trip. This relay to be initiated by any customer line fault relay.

9. ____ Device Type: Voltage Transformer

   Number Required: 3 connected grounded wye line side and either broken-delta or grounded-wye on secondary side.

   Purpose: Provide voltage to 59G or 27 relay for faults involving ground on the ComEd system. Preferred connection is broken-delta however secondary side connected grounded-wye is acceptable. If this VT is to provide voltage also for impedance relays or directional relays and is to be used for a 59G relay, then the VT may be 3 winding type with the third winding connected grounded-wye or the broken-delta connection may be provided by using an aux. VT (grounded-wye/broken-delta) in conjunction with VT provided by note 22.

10. ____ Device Type: Over or Undervoltage Relays Device #: 59G or 27

    Number Required: 1 if 59G relay or 3 if 27 relay

    Purpose: Provide for tripping of customer breaker(s) via time delay in the event of a fault of ComEd system involving ground. If the VT's are connected broken-delta then the relays used is the 59G overvoltage type. If the VT's are connected grounded-wye on the secondary, then the relays used are the 27 undervoltage relays.

11. ____ Device Type: Fault Detector Device #: 50FD

    Number Required: 1 or 3 depending on type. CT ratio is _____

    Purpose: Fault Detector for 21-1 and 21-2 relays (notes 12 and 13).

12. ____ Device Type: Impedance Relay Device #: 21-1

    Number Required: 1

    Purpose: Provide for tripping of customer breaker in the event of a phase fault on the ComEd system. This relay is the Zone 1 impedance relay. This relay may be part of a stepped zone phase and ground distance relay package. If CT's are located on the low voltage side of the transformer and the VT is on the high voltage side, then this relay must receive delta current. See note 22 for required VT location. This relay may not be suitable for all locations.

Plan D - Notes for Relay Functional Requirements Specification (RFRS) Form and Preliminary Relay Requirements Diagram (continued)

13. Device Type: Impedance Relay plus Timer Device #: 21-2/2

    Number Required: 1 Impedance Relay plus 1 Timer

    Purpose: Provide for tripping of customer breaker in the event of a phase fault on the ComEd system. This relay is the Zone 2 impedance relay. This relay may be part of a stepped zone phase and ground distance relay package. If CT's are located on the low voltage side of the transformer and the VT is on the high voltage side, then this relay must receive delta current. See note 22 for required VT location. This relay may be on low voltage side (using CT's and VT's located on the low voltage side) if no 21-1 relay is used. The time should be capable of providing a trip time in the .5 second to 2 seconds range.

14. Device Type: Ground Overcurrent Relay Device #: 51G

    Number Required: 1

    Purpose: Provide for tripping of customer breaker in the event of a phase fault involving ground on the customer system. This relay may be in the customer neutral.

15. Device Type: Overcurrent Relay Device #: 51

    Number Required: 1

    Purpose: Provide for tripping of the customer breaker in the event of a phase fault on the customer system.

16. Device Type: Directional Power Relay Device #: 32

    Number Required: 1 or 3 depending on type.

    Purpose: Provide for tripping of the customer breaker if transformer size is smaller than generator, to limit power out if necessary to prevent damage to other customers, or to limit power out because of ComEd system constraints. This relay is not used for fault detection. This relay may be located in a CT located on the transformer secondary.

17. Device Type: Synchronizing Relay Device #: 25

    Number Required: as required by the number of generator and transformer breakers needing synchrochecking. Not needed for most induction type generators.

    Purpose: Provide for proper closing of breakers when customer generator(s) are to be paralleled to the ComEd system.

18. Device Type: Voltage Transformer

    Number Required: as required for synchronizing

    Purpose: Provide voltage for synchronizing relays. May be one connected phase to phase or may be part of a 3 phase voltage transformer package.

19. Device Type: Voltage Transformer

    Number Required: 3 connected grounded-wye/grounded-wye

    Purpose: Provide voltage for under/over voltage and under/over frequency relays.

Plan D - Notes for Relay Functional Requirements Specification (RFRS) Form and Preliminary Relay Requirements Diagram (continued)

20.____ Device Type: Under/over Frequency Relay Device #: 81U/O

Number Required: 1

Purpose: Provide tripping of customer breaker in the event the frequency fails to be maintained. This relay would be expected to operate if the customer should become isolated on the ComEd line and not be able to maintain the load. The relay should be a definite-time type with a capability of providing a trip time in the .5 second to 2 second range. A solid-state definite time type relay is recommended. The actual setting is to be determined on a case-by-case basis.

21.____ Device Type: Under/over voltage relay Device #: 27/59

Number Required: depends on type

Purpose: Provide tripping of customer breaker should the feeder or line voltage not be maintained within acceptable limits. This relay should be a definite-time type or an instantaneous type with a timer. The relay should be capable of providing a trip time in the .5 second to 2 second range. The actual setting is to be determined on a case-by-case basis.

22.____ Device Type: Voltage Transformer

Number Required: 3 connected grounded-wye/grounded-wye

Purpose: Provide voltage for impedance relays and power directional relays. May be part of same transformer package as described in note 19.

23.____ Device Type: Ground impedance relay Device #: 21G-1

Number Required: 1

Purpose: Provide for tripping of the customer circuit breaker in the event of a ground fault on the ComEd line.

24.____ Device Type: Out of step relay Device #: 78

Number Required: 1

Purpose: To provide generator clearing when the unit is experiencing stability problems. This device will be required if a stability study shows the likelihood of a problem.

25.____ Device Type: Impedance Relay plus Timer Device #: 21-3/2

Number Required: 1 Impedance Relay plus 1 Timer

Purpose: Provide for tripping of customer breaker in the event of a phase fault on the ComEd system. This relay is the Zone 2 impedance relay. This relay may be part of a stepped zone phase and ground distance relay package and may be part of a high-speed pilot protection scheme. If CT's are located on the low voltage side of the transformer and the VT is on the high voltage side, then this relay must receive delta current. See note 22 for required VT location. The time should be capable of providing a trip time in the .5 second to 2 seconds range.

Plan D - Notes for Relay Functional Requirements Specification (RFRS) Form and Preliminary Relay Requirements Diagram (continued)

26.____ Device Type: Ground directional overcurrent relay Device #: 67G-1

Number Required: 1

Purpose: To provide back-up protection for ground faults on the ComEd line for the contingency of the pilot protection scheme not being operational.

27.____ Device Type: Polarizing inputs

Number Required: As required

Purpose: To provide polarizing inputs to directional relays as required. May require additional CT's and PT's as determined by the system and the protective devices applied.

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Relay Functional Requirements Specifications - Plan D

CUSTOMER: _____ PD: _____ Ser No.: _____

Location: _____ Date: _____

Connected To: _____ First Issued: _____

The information below is to be furnished by the customer and returned to Commonwealth Edison company						Notes refer to "preliminary" relay requirements for **PLAN D** Note #	Initiated by relays at left, as indicated				
DEVICE NO.	FUNCTION	TYPE*	CONN.	C.T. RATIO	P.T. RATIO		LBB	TRIP TRANS C.B.	TRIP GEN C.B.	TRIP LINE C.B.	SUPV. CLOSE
	PILOT PROTECTION SCHEME										
21-R	REVERSE LOOKING PHASE IMPEDANCE					7					
21G-3	GROUND IMPEDANCE					7					
67G	GROUND DIRECTIONAL OVERCURRENT					7					
21-3/2	PHASE IMPEDANCE & TIMER					7, 13					
25-1	SYNCHRONIZING					17					
25-2	SYNCHRONIZING					17					
25-3	SYNCHRONIZING					17					
27/59	UNDER/OVER VOLTAGE					21					
	LBB					8					
27	UNDERVOLTAGE					10					
59G	OVERVOLTAGE					10					
21-1	IMPEDANCE					12					
21-2/2	IMPEDANCE & TIMER					13					
50FD	FAULT DETECTOR					11					

*Relays should be approved by ComEd before customer purchase.

ADDITIONAL NOTES: _____

RETURN TO: _____
(Engineer)

ADDRESS: ComEd
Relay and Protection Services
2 Lincoln Centre
Oakbrook Terrace, Illinois 60181-4260

RETURNED BY: _____
CUSTOMER/CONSULTANT (Signature/Date)

Plan D - Notes for Relay Functional Requirements Specification (RFRS)
Form and Preliminary Relay Requirements Diagram (continued)

ComEd
An Exelon Company

CUSTOMER: _____ PD: _____ Ser No.: _____

Location: _____ Date: _____

Connected To: _____ First Issued: _____

The information below is to be furnished by the customer and returned to Commonwealth Edison company						Notes refer to "preliminary" relay requirements for **PLAN D** Note #	Initiated by relays at left, as indicated				
DEVICE NO.	FUNCTION	TYPE*	CONN.	C.T. RATIO	P.T. RATIO		LBB	TRIP TRANS C.B.	TRIP GEN C.B.	TRIP LINE C.B.	SUPV. CLOSE
32	DIRECTIONAL POWER					16					
51	OVERCURRENT					15					
51G	GROUND OVERCURRENT					14					
81	UNDER/OVER FREQ.					20					
21G-1	GROUND IMPEDANCE					23					
21/78	OUT OF STEP					24					
67G-1	DIRECTIONAL OVERCURRENT					26					
	TRANSFER TRIP RCVR.					6					
	TRANSFER TRIP XMTR.					6					

*Relays should be approved by ComEd before customer purchase.

ADDITIONAL NOTES: 1) The Basler BE-1 relay will be installed at the closing circuit to each generator output breaker in addition to other autosynchronizing devices as a final check of synchronism. 2) If multifunctio microprocessor-based generator protection relays are used, then two such relays per generator must be used to comply with NERC guidelines for single contingency failures.

_____

_____

_____

_____

RETURN TO: _____
(Engineer)

ADDRESS: ComEd
Relay and Protection Services
2 Lincoln Centre
Oakbrook Terrace, Illinois 60181-4260

RETURNED BY: _____
CUSTOMER/CONSULTANT (Signature/Date)

ComEd

An Exelon Company

APPENDIX 6: WIND AND PHOTOVOLTAIC GENERATOR APPLICATION FORM

Wind and Photovoltaic Generator Application Form

The following information is required by ComEd for approval of the Customer's Wind or Photovoltaic generating system (40 kW or less) to operate in parallel with the ComEd system:

Section 1: Customer Information

Applicant's Name _____

Address: Street _____

City_____State _____ Zip Code _____

Daytime Phone: (____) _____ Evening Phone: (____)_____

Mailing Address (if different than above):

Address: Street _____

City_____State _____ Zip Code _____

Section 2: Description of the Facility

Location of Facility: (address) _____

Separate Manual Utility Accessible Disconnect – Location: _____

Type of Facility: (check one) ☐ Wind ☐ Photovoltaic

Principal Components:

Photovoltaic Panel Manufacturer & Model: _____

and/or Wind Turbine/Generator Manufacturer & Model: _____

Inverter/Generator Serial Number: _____

Inverter Power Rating: _____

or Generator Output Capacity (in kilowatts, AC): _____

APPENDIX 6: WIND AND PHOTOVOLTAIC GENERATOR APPLICATION FORM (continued)

Inverter Protection Setpoints: _____

Undervoltage(27): _____

Overvoltage (59): _____

Over/Under Frequency (81): _____

Proposed Interchange Meter Location on Building: (check one)

☐ Outside North ☐ Outside South ☐ Outside East ☐ Outside West ☐ Other

The generating facility's inverter is listed per Underwriters Laboratories (UL) 1741, "Standard for Static Inverters and Charge Controllers for Use in Photovoltaic Power Systems", and equipped with non-adjustable setpoints and utility interactive (non-islanding).

Equipment Vendor (signed): _____ Date: _____

Equipment Vendor (printed): _____

Company: _____

Section 3: Installer Information

Licensed Electrician: _____ Contractor #: _____

Company: _____

Address: Street _____

City_____ State _____ Zip Code _____

Daytime Phone: (_____)_____

The generating facility has been installed in compliance with the current version of IEEE 929, "Recommended Practice for Utility Interface of Photovoltaic (PV) Systems"; "ComEd's Interconnection Guidelines for Photovoltaic and Wind Power Systems"; and with all applicable requirements of the National Electric Code and the local governing building and electrical codes.

Electrician (signed): _____ Date Installed: _____

APPENDIX 6: WIND AND PHOTOVOLTAIC GENERATOR APPLICATION FORM (continued)

Section 4: Certifications

The system has been installed to my satisfaction and I have been given system warranty information and an operating manual, and have been instructed in the operation of the system. I certify that the above information is true and correct to the best of my knowledge. Furthermore, I certify that in no event will ownership (as identified below) of these generation facilities by any electric utility, electric utility holding company, or any combination thereof exceed fifty (50) percent of the equity interest in the facilities. I have also identified any owner holding an equity interest in the facilities of 10 percent or more.

Ownership (Please state all owners, including % ownership)

_____

_____

_____

Signed (Owner): _____ Date: _____

_____

Section 5: Utility Information (To Be Filled Out By ComEd)

ComEd Transformer (associated with Interchange Meter) location number : _____

ComEd Interchange Meter Number : _____

ComEd Feeder Number : _____

ComEd Customer Account Number: _____

Protection Test by (over 25 kVA): _____ Test Date:_____

System Approved by: _____ Approval Date:_____

APPENDIX 7: PRE-INTERCONNECT INSPECTION STANDARDS

Inspection Standards for Generation Interconnected at 34.5kV and Lower

Acceptance Tests

The two types of acceptance tests are:

- Initial current and potential transformer acceptance tests
- Relay acceptance testing

Initial Current And Potential Transformer Acceptance Tests

These tests verify that the current transformers (CTs) and potential transformers (PTs) have the correct ratio, polarity, and burden and can be expected to function as per manufacturers specifications. Before these tests, ComEd must have the latest revision of the vendor prints for the equipment in order to verify nameplate data and get information needed for testing.

Current transformer (CT) tests. These tests include the following:

- Ratio test with enough current through the CT to be able to verify that the ratio of the CT agrees with the ratio on the customer's prints
- Polarity test using a battery or some other suitable method in order to verify the CT polarity as installed agrees with the customer prints
- Saturation curves test to confirm the manufacturers data for the point at which the CTs will saturate
- Insulation resistance testing of secondary wiring to verify that no grounds in the CT secondary exist other than the one designated in the circuit
- Lamping (continuity) test to verify continuity and prove all connections agree with customer prints for all devices in each secondary current circuit
- Current tests to verify the phasing of the currents before energizing by the lamping method

Potential transformer (PT) tests. These tests include the following:

- Polarity test to verify polarity of each PT as installed agrees with customer print
- Ratio test to verify the specified ratio of the PT with the customer print
- Hi-potential test to verify that the PT will not "break-down" when full potential plus 10% is applied
- Lamping (continuity) test to verify the continuity of the potential to all of the relays and to verify only one ground in the circuit

APPENDIX 7: PRE-INTERCONNECT INSPECTION STANDARDS (continued)

Relay Acceptance Testing

The relay manufacturers recommended acceptance test as outlined in the relay instruction manual must be completed.

Settings

After ComEd approves the specified relay settings, ComEd personnel are required to witness the testing and setting of the relays. ComEd and the customer's testing personnel must have copies of the approved settings 10 working days before testing begins.

Control Tests

ComEd personnel will witness control checks that include functional verification that all protective and control relay outputs operate equipment in agreement with customer schematic prints. Functional trip checks will be witnessed. Functional trip checks shall include operation of the primary interrupting device.

In Service Tests

ComEd personnel will witness all initial in-service tests including:

- Voltage tests to verify the phasing of the ComEd service and the customer equipment
- Primary voltage and phasing tests to verify the PT phases after the voltage phasing is known
- Current tests to verify the phasing of the currents by using an ammeter and phase angle meter Appropriately located test switches shall be installed to provide for such testing.
- Distance (impedance) relay directionality test to verify that the distance relay is "looking" in the correct tripping direction. This must be a mutually agreed on test.
- Final synchronizing tests to verify the synchronizing of the customer generator to the ComEd system. A phase angle meter must be used.

APPENDIX 7: PRE-INTERCONNECT INSPECTION STANDARDS (continued)

Inspection Standards for Generation Interconnected at 69kV and Higher

Witness Testing

Witness testing requires a ComEd testing representative to be on site during testing to verify that equipment operates properly. A "Witness Test List" will be provided with a specific list of tests required. Overall functional tests such as through fault tests and functional trip testing will be witness tested.

The ComEd testing department shall be notified 10 working days prior to any tests in order to allow for scheduling of the ComEd tester's time. The ComEd testing department shall be given one week to review any testing documentation upon receipt from the customer's testing representative. Testing documentation for a particular piece of equipment shall be received as a package.

Testing at the generator site follows review and approval of the customer's relay settings and protective relaying schematics. Testing will not commence until the Relay and Protection Services Department has reviewed and approved all required schematics and settings and these items have been delivered to the testing department. The main items that require witness testing by ComEd are as follows (the "Witness Test List" for a given site will contain specifics):

- Protective sensing circuit (CTs and PTs) and protective relay acceptance tests
- Relay calibration tests per approved settings
- Functional checks of relay sensing circuits per approved schematics
- Functional checks of relay tripping circuits including breaker tripping per approved schematics
- Functional checks of relay alarm circuits per approved schematics
- Overall primary current through fault tests of line, transformer, and bus differential circuits and a final trip check of these circuits
- Overall coordination test of permissive overreach line protection schemes and a final trip check of these circuits,
- Energization of customer lines and transformers to follow directly after completion and acceptance of overall tests
- In-service current and voltage circuit tests to occur upon initial loading of equipment
- Initial synchronization tests

Initial livening of high voltage circuits will not be allowed until satisfactory completion of all testing items including required through fault tests have been witnessed and approved. Livening equipment without these tests will result in disconnection from the ComEd system

APPENDIX 7: PRE-INTERCONNECT INSPECTION STANDARDS (continued)

Ground Grid

Verify that all structures and fences are connected to their respective ground grids

Measure overall switchyard ground grid resistance using fall of potential or equivalent method

Verify that microwave ground grid, if separate from station ground, is connected to station ground per design. Maximum allowable switchyard ground grid resistance is 0.5 ohm.

Equipment

Perform power factor (dissipation factor) test on:

- All high voltage circuit breakers
- Potential transformers
- Potential devices
- Free standing current transformers
- Power transformers
- Lightning arresters
- All other high voltage equipment except stand off insulators

Current Transformers

Tests apply to all current transformers supplying switchyard relays. These tests are as follows:

- Test insulation resistance of all individual current transformer secondary windings. Required CT insulation resistance at 500 volts DC is 1 megohm minimum.
- Ratio test by passing the current through the CT primary and measuring the secondary current. Acceptable as tested ratio is the nameplate ratio plus or minus CT accuracy classification.
- Test all multi-ratio transformers for ratio of all secondary taps by applying approximately 100 volts AC across the entire winding and measuring voltage on each tap lead. Voltage ratios measured will equal CT ratios plus or minus the accuracy class of the CT.
- Test each CT for polarity. Perform a secondary excitation (saturation) test on all primary (non-auxiliary) CT's on the in-service tap. Test results should match manufacturer's specification plus or minus 10 %.
- Verify ratio and polarity as found match the ratio and polarity specified on design documents and equipment nameplates

APPENDIX 7: PRE-INTERCONNECT INSPECTION STANDARDS (continued)

Potential Devices

- Test insulation resistance of the 5 kV primary winding to case at 1,000 volts DC
- Test insulation resistance of secondary winding to secondary winding at 500 volts DC. Test insulation resistance of secondary to ground at 500 volts DC. Primary winding insulation resistance minimum is 5 megohms; secondary minimum is 1 megohm.
- Backfeed secondary winding(s) at rated voltage and measure exciting current.
- Verify closing the capacitor grounding switch shorts, and grounds the voltage transformer primary winding
- Verify protective gap setting
- Verify ratio and polarity
- Calibrate output for correct phase angle, power factor, and magnitude if the device has provisions for adjustment

High Voltage Circuit Breakers

- Perform all manufacturers recommended tests. Verify mechanical tolerances as installed meet manufacturer specification.
- Verify synchronization of individual interrupting chambers within each pole and between poles
- Measure the time to open after trip initiation, time to close after close initiation, time to close after close initiation and time to trip when closing into a made-up trip (trip free operation)
- Measure main contact resistance. Verify set points of all timers, temperature, and pressure sensing equipment.
- Verify all breaker controls, annunciation, alarms and auxiliary equipment function as designed per manufacturer requirements and specifications
- Functionally test trip and close permissive circuits and interlocks
- Test/verify all auxiliary contact functions for breaker operation, motor operated disconnect, protective relaying, control, remote and local annunciation
- Time auxiliary contact used in breaker failure protection

Annunciator

- Verify that all inputs result in correct outputs per schematic/design documents by actuating initiating devices

APPENDIX 7: PRE-INTERCONNECT INSPECTION STANDARDS (continued)

Current Circuits

- Verify that ratio, polarity, and all secondary connections conform exactly to the three line current diagram
- Verify one ground per secondary circuit by removing the ground and testing insulation resistance at 500 volts DC. Minimum required value is 1 megohm.
- Verify all current shorting switches, bars and other shorting devices provide a continuous circuit when relays meters, etc. are removed from the circuit
- Test overall connection of secondary current circuits used for high voltage metering, control, and protection by means of primary current injection
- Test all polarizing current transformers and circuitry providing current to switchyard equipment by primary injection
- Measure total CT circuit DC resistance for all bus differential relay circuits as requested by ComEd

Potential Circuits

- Verify that ratio, polarity, and all secondary connections conform exactly to the three line potential diagram
- Verify one safety ground per circuit by removing the ground and checking circuit insulation resistance at 500 volts DC. Minimum value is 1 megohm.

Motor Operated Disconnect

- Verify open/close motor rotation, hand crank safety interlock, disconnect blades move simultaneously, blades make proper contact, and have specified 'wipe' in their saddles
- Verify manual stops are set
- Verify operation by hand crank
- Verify status and operation of all auxiliary contacts connected to the operator or switch linkage by functional test

Panel Meters and Transducers

- Verify equipment rating (correct CT & PT ratios used)
- Perform meter and transducer calibration at cardinal points

APPENDIX 7: PRE-INTERCONNECT INSPECTION STANDARDS (continued)

Protective Relays

- Perform all manufacturers recommended acceptance tests
- Apply relay setpoints as specified by approved design documents
- Verify all functions used and relay characteristics by application of voltage and/or current
- Plot the impedance characteristic of all mho type relays. Inverse time overcurrent relays require test at three points along the timing curve. Phase comparison type relays require a check of all timers, setpoints, sequence network output and an end-to-end alignment and dynamic coordination (satellite) test. ComEd will provide test support at remote ComEd owned terminals.
- Verify correct CT and PT ratios have been used
- Verify outputs (trip, transfer trip, reclose, alarm, annunciator input, initiate, etc.) of all protective devices

SCADA

- Supply and verify field cable to the remote control and indication equipment cabinet. ComEd will install SCADA equipment. Operation of all points will be verified by functional test. Switchyard installer will operate all required input devices and apply current/voltage to the inputs of transducers to produce outputs to prove SCADA at ComEd request.
- It is suggested that all field cables be terminated in the SCADA cabinet(s) by the switchyard installer using plastic hardware (screws and washers) to isolate the SCADA equipment until ready for test. ComEd will replace plastic with metallic hardware during commissioning of the SCADA equipment.

Automatic Throw-Over

- Perform an insulation test of all live parts and cable at 1,000 volts DC. Minimum value 1 megohm for equipment rated 480 volts or less.
- Verify operation by functional test
- Verify phasing of normal and reserve feeds
- Verify installation is per latest design documents
- Perform all manufacturers recommended tests
- Verify and record all control relay and timer settings

APPENDIX 7: PRE-INTERCONNECT INSPECTION STANDARDS (continued)

Battery and Charger

- Set charger float and equalize voltages
- Set over/under voltage, open battery detector, and ground detector alarms
- Perform receipt inspection of battery per manufacturer instructions
- Test insulation resistance of battery cable and distribution panels at 500 volts DC. Minimum value 1 megohm.
- Measure intercell resistance after connectors have been torqued
- Perform initial charge per manufacturer recommendation
- Measure and record cell voltage and specific gravity one week after completion of initial charge
- Measure and record cell terminal voltages monthly

Auxiliary power transformers

- Perform insulation resistance phase to ground and high voltage winding to low voltage winding
- Test windings rated 480 volts or less at 500 volts DC, windings rated above 480 volts at 2500 volts DC. Minimum insulation resistance for 480 volt rated equipment is 1 megohm, over 480 volts is 1 megohm per kV plus 1 megohm.
- Perform a turns ratio test
- Set in service taps
- Verify output voltage and phasing

Control Circuits

- Verify that all control circuits conform to the latest revision of applicable approved control schematics. IE, test individual contacts and logic strings by actuation of contacts.
- Verify that trip/close/initiate/annunciation and alarm signals are routed through test/isolation switches per schematic
- Verify the placement and operation of blocking diodes

Microwave Equipment

- Verify all connections conform to the latest revision of applicable design documents up to the Motorola demarcation cabinet

Fire Detection/Suppression

- Verify installation functions per the latest revision applicable design documents if ComEd owned protective equipment is located within customer facilities

APPENDIX 7: PRE-INTERCONNECT INSPECTION STANDARDS (continued)

Lifted Leads and Jumpers

- All lifted leads (cable conductors, wires) and temporary jumpers not shown on the design documents are numbered and tagged in the field
- All temporary control jumpers are constructed using #10 wire with red insulation. A log will be kept for all lifted leads and jumpers. The log will include the following data:
- Lifted lead or jumper number
- Panel number or physical location
- Schematic and wiring diagram affected
- Function of the jumper
- Reason for lifting the lead
- Name of the person performing the modification and company affiliation

Through Fault Tests

A through fault test is an overall primary current injection test. It is not an actual or staged fault test. Test currents obtained will be much lower than fault currents since the source voltage used for the test will be much less than actual system voltages. This test injects primary current into all three phases of the actual high voltage equipment.

Through fault tests of high voltage busses or lines can be accomplished with very low voltage (120 or 240V) sources. Through fault tests for tap line and transformer differential circuits may be combined into one test. For transformer tests, voltage may be connected on either the primary high voltage side or secondary high voltage side of the equipment as necessary to obtain a measurable amount of test current. All three phases of the side of the equipment which is not connected to the test voltage are shorted. The current injected will flow through the primary side of all the CTs of the differential circuit under test. A through fault test of a transformer may connect a voltage source to the high side of a transformer at a point such that the current will flow through the high side transformer differential CTs. The transformer will be shorted on the low side such that the current will flow through the low side transformer differential CTs.

Monitoring during the test proves proper direction of currents in all differential relay elements. Measuring currents and phase angles at test switches for the differential relay circuit will do this . Another measurement method is to obtain proper metering and oscillographic information from a microprocessor based differential relay. In addition, this test also verifies the overall ratio of the transformer windings.

Upon completion of a through fault test, a final circuit breaker trip test is done by injecting secondary current into the differential relay under test and tripping its lockout. Equipment is energized directly following completion and acceptance of these final overall tests. ComEd will provide a sample of documentation of a GSU transformer through fault test if requested.

APPENDIX 7: PRE-INTERCONNECT INSPECTION STANDARDS (continued)

Initial In-Service Tests

- The switchyard will be energized using written procedures supplied by the installer and approved by ComEd. The procedure and results of all installation testing will be supplied to ComEd at least fifteen working days in advance of livening.
- All protective relaying will be in service prior to energization. Any temporary modifications to the protective scheme must be approved by ComEd.
- Individual relay trips may be disabled after livening to facilitate testing. The procedure will energize the smallest amount of new equipment and allow for in service phasing tests, current and potential tests to verify the ratio, polarity, primary and secondary connections to all relays, test switches, transducers and meters.
- Magnitude and phase angle of secondary currents and voltages will be measured at all locations Appropriate test switches shall be incorporated into the design to facilitate such testing.
- Individual current transformers will be shorted to prove their contribution to schemes requiring multiple current inputs
- Individual potential devices will be grounded to verify broken delta secondary connections
- All initial in service tests must be witnessed by ComEd
- Perform in service test of all directional relays to verify connections provide the required tripping direction (Example, KD relay 6 of 9 test). For relays requiring residual current, the appropriate phase current transformers will be shorted and/or jumpered to force current through the residual elements.
- All data including system configuration, direction of system power flow, test equipment connection, method and test results will be recorded in detail sufficient to recreate the tests
- Potential inputs to all automatic synchronizing equipment and/or synchroscopes will be verified using primary voltage wherever possible
- Automatic close outputs and/or synchroscope indication also will be verified prior to connecting generation to the ComEd system

APPENDIX 7 - PRE-INTERCONNECT INSPECTION STANDARDS (continued)

General Documentation

ComEd requires the following documentation:

- Complete nameplate data for all equipment installed including manufacturer, make, model, serial number, instruction book/leaflet number, all applicable ratings (voltage, current, BIL, etc.)
- One copy of all test results must include company affiliation of the test technician, date and signature of the test technician for each piece of equipment and control circuit installed, including the test method and equipment used
- Include the applied voltage/current levels, megohm values, device operating temperatures, pressures, time delays, the date the test was performed, the signature and company affiliation of the person performing the test and the result of the test evaluation (pass/fail, acceptable, unacceptable) using ComEd supplied criteria
- Two copies of the manufacturer specifications, instruction manual and design documents provided by the manufacturer for all equipment installed (T&DA requirement only, not the total ComEd requirement)
- Two copies of all final, current and correct as-built design documents (such as schematic & wiring diagrams, key diagrams one lines, cable tabulation, structural and physical drawings).
- Two copies of the design document index (T&DA only, not the total ComEd requirement)
- Lifted lead and jumper log listing locations and reasons for lifted conductors or temporary jumpers

Specific Documentation Requirements

Current Transformers

As shown on Field Reference Manual FRM VII-8 data sheets, pages 6 through 11 dated 7/1/96.

Potential Device

As shown on Field Reference Manual FRM VII-9 data sheets, pages 8 and 9 dated 7/1/96. Power factor test results, method/equipment used to obtain the results.

Fire Detection/Suppression

Supply licensed contractor test results and certification that the installation meets all applicable codes.

APPENDIX 7 - PRE-INTERCONNECT INSPECTION STANDARDS (continued)

Control /Potential/Current Circuits

Schematic drawing number, revision number, and in instances where multiple circuits are shown on one diagram, a description of the circuit. Date signature and company affiliation of the person verifying field installation of each control circuit is complete and correct per the latest revision of the schematic diagram. Signature indicates that test data for all equipment shown on the schematic has been reviewed and is within manufactures and/or ComEd acceptance criteria. In all instances where circuits have been altered or incomplete, (lifted leads or temporary jumpers), a list of those alterations and incomplete items.

Battery/Charger

Float, equalize, ground alarm set points applied in the field. Cell voltages and specific gravities after the initial on-site charge. Monthly report including pilot cell specific gravity, overall battery voltage and a record of the dates and duration of equalizing charges.

Ground Grid

Grid resistance measurement and method of test. Written verification that all equipment and fencing is connected to their respective grids.

Circuit Breakers

Power factor test results, method/equipment used to obtain the results. Timing/synchronizing test results. All controls documented per Control /Potential/Current Circuits requirements. Current transformers as specified per current transformer documentation requirements. Process or data sheets used to record as-built mechanical tolerances/settings, temperature and pressure switch settings and timer settings.

Automatic Throwovers

Process or data sheets used to record as-left time delays and control relay set points.

Protective Relays:

For microprocessor relays a signed, dated print out from each relay listing all applied settings and installed software revision. For all other relays, a signed and dated copy of the relay setting order or equivalent design document showing the actual setting applied, electrical test results verifying the relay setpoints and relay operation. Data must include overall current and potential device ratios (including auxiliary transformers).

Power Factor (Doble) Tests:

Record results on supplied forms or equivalent.
Chicago, IL 60603-0767
(312) 394-8338

APPENDIX 8: APPROVAL FOR OPERATION OF GENERATION IN PARALLEL WITH COMED SYSTEM

Customer Name:_____

Address: _____

City: _____ **State:** _____ **Zip:** _____

This is to confirm that the generation facility located at the above location has been tested by the Customer or Customer's representative as required by ComEd, and said tests witnessed by a ComEd representative.

The above generation facility has successfully demonstrated the ability to operate in parallel with the ComEd system, and said operation has been witnessed by a ComEd representative.

The above generation facility is hereby permitted to operate in parallel with the ComEd system.

_____ _____

ComEd Representative Date

_____ _____

Customer Representative Date

APPENDIX 9: APPROVED RELAYS FOR USE ON THE COMED SYSTEM

The following is a partial list of relays that ComEd has approved. The intention of this list is to avoid the customer's use of unapproved relays. However, using only approved relays does not take the place of submitting to ComEd for approval; the non-utility generation installation's proposed list of relays and application including settings. Even an approved relay can be misapplied. To avoid problems, the customer needs to seek the relay manufacturer's approval of the relay application before submitting the protection scheme to ComEd for approval. For relays ComEd has not tested, IEEE/ANSI C37.90 certified test reports by the manufacturer and independent laboratories should be submitted to ComEd along with the complete manufacturer instruction books and application guides for the relay model being used. Generally speaking, early and periodic exchange of information with ComEd is the best way to insure a successful project.

The appearance of a relay on the list is not a guarantee of the relay nor, does it constitute a recommendation of any relay application to protect the customer's equipment. Nor does appearance on the list address software, firmware or hardware revisions. Any questions regarding the acceptability of a relay should be directed to the System Protection Department.

MANUFACTURER	MODEL
BASLER	BE1-27/59
	BE1-51C
	BE1-81 O/U
BECKWITH	M-3420
	M-3430
	M-3520
SCHWEITZER	SEL-2PG10
	SEL-251
	SEL-279H-2
	SEL-321-1
	SEL-351A
	SEL-351S
	SEL-501
	SEL-587